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ABSTRACT

The Science Assessment Research Project assessed the science achievement and attitudes of 18,000 9-, 13-, and 17-year-old students nationwide. This study investigated the attitudes of a random sample of 1,955 17-year-old students' attitudes toward women in science as indicated by responses to seven Likert items administered during the assessment. Specific research questions addressed were: (1) What are the attitudes of secondary school youth toward women as scientists? (2) Are these attitudes different for males and females? (3) At what age do they originate? (4) What are some of the correlates of adolescents' attitudes toward the role of women in science? (5) What is the potential for such attitudes influencing science career choices? Among the findings reported are those indicating that, in general, 17-year-olds expressed a positive attitude toward the role of women in science and that girls expressed significantly more positive attitudes toward women in science than did boys. Similar findings were noted when these results were compared to those of 13-year-olds, suggesting that the male sex-bias attitude is stable across age group (and race). Although the source of the sex-bias attitude remains unknown, it seems to be related to slightly lower ability. (JN)

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WOMEN IN SCIENCE: PERCEPTIONS OF SECONDARY SCHOOL STUDENTS

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Women in Science: Perceptions of Secondary School Students

Girls tend to make decisions during their formative years that leads them away from careers in science. These decisions seem related to the lack of satisfaction they find in their science classes or other science experiences. This lack of statisfaction is derived from their developmental characteristics (Harding & Sutoris, 1984) and from external pressures they perceive in their environment.

According to Harding and Sutoris (1984), the self development of girls and boys is often different. Girls may be characterized as deriving satisfaction from intimacy, reparation, and reciprocal relationships. They are person-oriented and perceive little opportunity for such intimacy in science, particularly the physical sciences. They choose instead, careers as teachers, social workers, psychologists, and other humanistic careers. Boys on the other hand, derive satisfaction from autonomous activity. They are object oriented, much less inclined toward intimacy, and seek possession and control. Science is perceived to provide a setting for such activity and they find it more satisfying than do girls.

Girls throughout the world express less interest in science (Gardner, 1984) and score lower on measures of science achievement (Welch & Rakow, 1984). This further contributes to their dissatisfaction and their decisions to opt out of science careers.

It may be possible to change this situation by a) changing the image of science among girls, or b) modifying feminine personality characteristics. To date, little effort has been directed toward this

solution and I know of few successful attempts. (Harvard Project Physics tried to make physics more appealing to girls by using a historical approach. Although our research showed girls did achieve in this course [Welch, 1973], the course has not attracted large numbers of girls to the physics class rooms.)

The second factor influencing girl satisfaction in science (and the resulting career decisions), is the press of the socio-psychological environment they encounter at home, in school, and in their daily lives. This study attempts to investigate one of these environmental factors, peer attitude toward women in science. What are the attitudes of our nations' secondary school youth toward women as scientists? Are these attitudes different for males and females? At what age do they originate? What are some of the correlates of adolescents' attitudes towards the role of women in science? What is the potential for such attitudes influencing science career choices?

Procedures

Seven Likert items measuring student attitude toward women in science were written and administered to a national random sample of 1,955 17-year-olds. The items tapped student perceptions of the relative ability of males and females on several aspects of science; knowledge, competancy, careers, technical skills, and logical reasoning. A sample item is "Science careers are just as appropriate for women as for men." The response option to each item was 5 - strongly agree, 4 - agree, 3 - uncertain, 2 - disagree, 1 - strongly disagree. Negatively worded items were reflected so that a high score

means a positive attitude toward the role of women in science. A low score (negative attitude) indicates a belief that compared to men, women are unlikely to do well in the world of science. We have labeled the positive response sex-equality and the negative, science sex-bias.

A scale called The Women in Science Scale (WISS) was created by summing responses across the seven items. The internal consistency (Cronbach alpha) of the scale is .88 on the present sample.

Data were also gathered on the WISS from a replication sample of 2,010 17-year-old students and from 2,025 13-year-old students. The testing was carried out in 1981-82 as part of the national assessment in science conducted at the University of Minnesota (Hueftle, Rakow & Welch, 1983). Additional information on student ability, science achievement, science careers, and science attitude were gathered from these same students. The carefully selected sample permits generalizing to the nation with a reasonably high level of confidence.

Results

The results of the study for 17-year-olds are presented in Table 1. The two different national random samples are called Sample A and Sample B (see Table 1).

In general, 17-year-olds expressed a positive attitude toward the role of women in science. The mean item response was 4.1 on the 5 point scale meaning they tend to "agree" with statements about the equality of the sexes in the field of science. On a scale that ranges from 7 to 35, the mean response was about 29, or 83% of the total. There is remarkable consistency in the results from the two independent random samples.

TABLE 1

Attitudes Toward Women in Science
Age 17

ITEM	KEYED RESPONSE	SAMPLE A (1955) MEAN	SD	SAMPLE B (2010) MEAN	SD
1. Men need to know more about science than women.	(SD)	3.97	1.06	4.08	1.06
2. Girls can do just as well as boys in science.	(SA)	4.40	0.86	4.43	0.85
3. Science is more for males than females.	(SD)	4.11	1.04	4.18	1.00
4. Science careers are just as appropriate for women as for men.	(SA)	4.28	0.83	4.32	0.79
5. Working with advanced technology is more for males than for females.	(SD)	4.02	1.05	4.04	1.02
6. Studying about science is just as important for females as for males.	(SA)	4.22	0.87	4.25	1.20
7. More men than women have the logical ability to become scientists.	(SD)	3.74	1.19	3.72	1.20
Total Scale		28.84	5.24	29.08	5.07

4a

The second question of this study was concerned with the possible differences in the attitudes held by 17-year-old boys and girls. Results of this analysis are shown in Table 2 (see Table 2).

Seventeen-year-old girls express significantly more positive attitudes toward women in science than do boys. The finding was replicated on two national random samples. Girls are about two-thirds of a standard deviation above the mean for boys. Similar results were found on each of the seven items as well. The item results are presented in Table 3. The percentage of boys and girls agreeing or strongly agreeing with the keyed response is shown. The keyed response is the one reflecting an enlightened or sex-equality attitude. Persons scoring low on an item are expressing sex-biased attitudes. That is, they perceive science to be primarily a male subject (see Table 3). Although both males and females were above the mid-point on the scale, the fact that males showed more sex-bias than girls is viewed as an important, albeit, disappointing finding. Negative male attitudes toward their opposite sex class mates would seem to contribute to the environmental pressure girls experience in considering science careers.

This finding, which might be called male chauvinism, prompted further investigation into the extent of these results. That is, did 13-year-olds as well as blacks exhibit these attitudes. Secondly, what factors are related to the sex-bias attitude that may help explain its origin?

A national sample of 2,025 13-year-olds were asked these same questions. In addition, the results for age 17 were examined

TABLE 2

Women in Science
Attitudes of Boys and Girls

WISS Total Scores

SAMPLE	MEAN RESPONSE			
	MALE	FEMALE	DIFFERENCE	t
A (n = 1,955)	26.74 (5.5)	30.52 (4.5)	-3.78	16.7*
B (n = 2,010)	27.32 (5.2)	30.67 (4.6)	-3.35	15.4*

( ) Standard deviations

* Significant at p <.001

TABLE 3

Women in Science
Attitudes of Boys and Girls

ITEM	KEYED RESPONSE	PERCENT KEYED RESPONSE MALE (919)	PERCENT KEYED RESPONSE FEMALE (1036)	z*
1. Men need to know more about science than women.	Disagree	66.9	83.1	8.4
2. Girls can do just as well as boys in science.	Agree	84.9	94.9	7.1
3. Science is more for males than females.	Disagree	68.8	87.7	*
4. Science careers are just as appropriate for women as for men.	Agree	82.8	94.1	*
5. Working with advanced technology is more for males than for females.	Disagree	66.1	84.5	*
6. Studying about science is just as important for females as for males.	Agree	81.0	92.6	*
7. More men than women have the logical ability to become scientists.	Disagree	51.1	74.9	*
Scale Average		71.7	87.4	

* All significant at $p < .0001$

questions. In addition, the results for age 17 were examined separately for whites and blacks. The findings of this further investigation are shown in Table 4 (see Table 4).

Apparently the male sex-bias attitude is stable across race and age group. Each group scored lower on the Women in Science Scale (WISS) than their female counterparts. Although black females showed less sex-equality concerning women in science, they were still considerably higher than black males.

Item results for blacks and 13-year-olds were similar to those for 17-year-olds. Significant differences were noted on each of the seven items of the scale.

The final analysis in this series of investigations was the correlation between scores on the WISS and other variables available in the national assessment data. The correlations were examined separately for 17-year-old males and females. The results are shown in Table 5 (see Table 5).

This phase of the research was mainly exploratory. We were interested in possible correlates of sex-equality attitudes. What factors are related to sex-biased attitudes? Preliminary investigations indicate that "enlighted" attitudes toward women in science are related moderately to ability indicators. That is, poorer students (both males and females) exhibit more sex role bias.

Other variables we examined showed low correlations; counselor influence, science class attitude, and type of instruction. Further investigation is occurring in this area and will be reported in a subsequent report.

TABLE 4

Women in Science
Attitudes of Males and Females
13-Year-Olds, 17-Year-Old Blacks
WISS Total Scores

GROUP	MEAN RESPONSE			
	MALES	FEMALES	DIFFERENCE	t
13-Year-Olds	26.1 (5.4)	30.1 (4.5)	-4.0	18.1*
17-Year-Olds				
Black	26.3 (4.5)	29.1 (4.6)	-2.8	13.8*
White	26.8 (5.7)	30.9 (4.4)	-4.1	18.2*

* significant at p <.0001

TABLE 5

Attitude Towards Women in Science
Correlation with Selected Variables

	PEARSON r	
VARIABLE	MALE	FEMALE
Science achievement	+.27	+.32
Science career interest	+.25	+.22
School grades	+.14	+.25
Science confidence	+.15	+.18

Discussion

This study sought to shed some light on possible environmental factors that may be influencing the reluctancy of women to choose careers in science. We found that although boys and girls were generally positive in their attitudes towards women in science, there were marked sex differences in their attitudes. Boys were less likely to believe that women would be as successful as men in science. The attitude is one of greater male science chauvinism.

It seems reasonable to conclude that such attitudes may have a detrimental effect on the career choices of women and perhaps on their science achievement. It is possible that these attitudes may reflect in part the fact that few women currently choose science careers. However, the differences in the perceptions of boys and girls suggests influence other than the numerical dominance of male.

The consistency of the results across several age and race groups suggests the attitude difference is pervasive. The source of the sex-bias attitude remains unknown although it does seem related slightly to lower ability. Eventually, programs and/or activities designed to address these attitudes seem warranted to try and remove one of the barriers women face in their pursuit of science careers. However, such programs seem premature at present until more is understood about the origins of these attitudes and their effect on science learning and on women who wish to become scientists.

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